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The European Patent Office (IPEA)
Erhardtstrasse 27
D-80298 Munich 2, Germany



Attn: D. Herry-Martin

**Re: International Application No. PCT/US 03/33701
E. I. du Pont de Nemours and Company
Our Ref.: HT3970 PCT**

Dear Sirs:

This letter is filed in response to the written opinion mailed 2 August 2004.

Substitute Sheets

Please withdraw the set of claims presently on file, in favor of the new set, submitted herewith, containing claims 1 to 16.

Amendments

The amended pages are enclosed in two copies: a copy showing the changes made (revision mode), and a second copy suitable for substitution in the application.

Page and line references are to the international application as published.

Claim 1 has been amended to recite that the two separate layers are bonded to each other at predefined positions by means of selected bounding yarns which are part of the layer which faces away from the skin, and to specify that the bounding yarns are woven or knitted or stitched through the ply (2) on the skin side. This amendment finds support in the description on page 4, at lines 5-8.

Claim 1 has further been amended to correct an obvious error [Rule 91.1(b) PCT]: the numeral "(3)", in the second to last line of the claim, has been corrected to read "(2)". The

numeral "(3)" was erroneously used to refer to "the layer that essentially faces the skin". It is clear from the description, for example, page 6, lines 23 to 31 ("List of reference numerals") in combination with Figure 2, that the correct numeral for referring to the layer facing the skin is the numeral "(2)".

Claim 13 has been amended by removing the dependency on itself.

The amendments to Claim 1 find basis in the application as filed, and hence are in compliance with Article 34(2)(b) PCT.

Remarks

Inventive step [Article 33(3) PCT]

The Examiner is of the opinion that the claims as filed lack an inventive step over WO 96/08174 (D1), in the light of DE 195 47 704 (D2).

The Applicant has chosen to argue using the problem-solution approach. The expression "closest prior art" is not an admission of the particular relevance of any document.

The Invention

The present invention, as defined by amended Claim 1, provides a multilayered textile fabric for breathable garments, comprising at least two separate layers, the two separate layers being bonded to each other by means of bounding yarns which are part of the layer which faces away from the skin, whose warp and weft yarns consist of aramid yarns or aramid twisted threads or aramid filament yarns or yarns made of blended fibres containing polybenzimidazole and aramid fibres, whereby the layers have different individual fibre degrees of fineness in order to bring about a fineness gradient over the thickness of the fabric, whereby the side of the layer that essentially faces the skin has the coarser individual fibre titer and the layer of the side facing away from the skin has the finer individual fibre titer.

The provision of a fineness gradient in combination with bounding yarns [(5) in Figure 2 of the Application] results in a fabric having excellent "wicking" ability: the perspiration of the wearer is quickly transported to the outer surface of the fabric, where it evaporates. This is particularly important in uses in which the wearer will perspire, such as in sports garments, and in uses in which the wearer will be exposed to flame or heat, such as in garments for fire-fighters. Trapped perspiration can result in wearer discomfort. In fire-fighter garments, trapped perspiration can result in increased weight of the garment, contributing to heat exhaustion. On exposure to flame or heat, trapped perspiration can result in excessive heat transfer to the wearer, and can result in steam burns.

Referring to Figure 2 of the application, the mode of action of the textile fabric (1) according to the invention can be described as follows. The fabric (1) is composed of at least two separate single plies (2,3) being bonded to each other at predefined positions (5) by the mean of selected bounding yarns which are part of the ply (3) which faces away from the skin. The bounding yarns are woven or knitted or stitched through the ply (2) on the skin side.

The bounding yarns are visible on this predefined position on the skin side (6) in the form of dots.

Moisture formed on the skin is absorbed by the fibre composing the bounding yarns forming the dots (5) located on the skin side (6). It is then transported by the capillary action of the fibres along the bounding yarns to the back of the ply or layer (3) by means of capillary action and the preferred direction of the bounding yarns towards the ply (3) facing away from the skin. On the side (3) facing away from the skin moisture quickly evaporates due to the comparatively large surface area. Consequently, the side (6), which faces the skin, always remains relatively dry in comparison to normal material, for example, normal aramid lining fabric.

D1 as “closest prior art”

D1 discloses a protective garment having an outer shell, a thermal liner and a moisture barrier consisting of a layer of fire-retardant, closed-cell foam material. The foam layer may be adhesively bonded to a layer of lightweight face cloth, made of Nomex (aramid) by dots of a suitable adhesive (D1; page 11, lines 5-7).

The problem to be solved over D1 is to provide a fabric having an enhanced ability to protect a wearer from moisture retention. The solution, as provided by the fabric of Claim 1, is to provide a fabric having “wicking” ability, whereby moisture is transported away from the wearer, by using an at least two-layer construction in which the layer that faces the skin has a coarser individual fibre titre than the layer facing away from the skin, and by bonding the at least two layers to each other by bounding yarns which are part of the layer that faces away from the skin the bounding yarns being woven or knitted or stitched through the ply (2) on the skin side.

This solution is not obvious from D1. First of all, D1 does not suggest the solution of using “wicking”. The garment disclosed by D1 is designed for “moisture resistance and thermal insulation” (D1; page 4, lines 7-8). The inventors of D1 comment:

Another advantage with such an arrangement is that the closed-cell form material does not absorb water, so that the overall ensemble does not get as heavy in conditions of high water saturation, and therefore reduces stress on the wearer since the weight is reduced. Furthermore, the TPP rating will remain more constant than prior art thermal liners, regardless of the amount of water saturation of the garment, since the thermal liner resists absorbing water. [D1, page 5, last paragraph]

In other words, the closed-cell foam of D1 avoids weight gain due to absorbed water by simply not absorbing water. The closed-cells of the foam *cannot* absorb water because they are closed. In contrast, in the fabric of the invention, the wearer is protected from moisture build-up by “wicking” which is a mechanism that involves absorption of moisture. A closed-cell foam cannot wick, because there can be no passage of moisture between closed cells.

Furthermore, D1 does not teach to use at least two layers in which the layer that faces the skin has a coarser individual fibre titre than the layer facing away from the skin:

The fabric of the invention is particularly suited for making garments for firefighters, as it provides a thermally resistant breathable barrier that prevents moisture buildup on the wearer’s skin. A conventional garment for a firefighter comprises in general four layers:

- (1) An inner liner;
- (2) A thermal liner;
- (3) A moisture barrier; and
- (4) An outer shell.

The fabric of the invention permits lightweight garments to be made, because it essentially combines layers (1) and (2), providing a thermal barrier in combination with an inner liner.

The approach taken in D1 is entirely different, and involves combining layers (2) and (3). See for example, page 4 of D1:

...the closed-cell foam material acts as a combined thermal liner and moisture barrier to provide a protective garment in which a separate, discrete moisture barrier and thermal liner is eliminated, so that the entire garment consists essentially of

an outer shell, a layer of closed-cell foam material and, preferably, an inner liner of lightweight face cloth material to prevent abrasion of the foam layer by the clothing of the wearer. [D1; page 4, lines 10-17]

In other words, D1 attempts to combine the moisture barrier and the thermal liner, whereas the fabric of the invention combines the inner liner with the thermal barrier.

In addition, D1 does not teach to bond at least two layers to each other by bounding yarns which are part of the layer that faces away from the skin, the bounding yarns being woven or knitted or stitched through the ply on the skin side. In the fabric of the invention, the bounding yarns establish a moisture transporting conduit between the wearer's skin and the outer surface. In contrast, D1 discloses that "*the foam layer 29 is adhesively bonded to a layer of lightweight face cloth 30...by dots 31 of a suitable adhesive.*" Bonding with adhesive does not lead to wicking, since adhesives, in general, are not water transporting. The adhesive does not pass through the layer next to the skin, but rather is between the face cloth 30 and the closed-cell foam, away from the skin. The adhesive cannot form a moisture transporting conduit.

The fabric of Claim 1 shows an inventive step with respect to D1. The arguments mentioned above with respect to Claim 1 apply equally to dependent Claims 2 to 13. Claims 2 to 13 are inventive over D1.

The articles of Claims 14, 15 and 16 comprise the inventive fabric of Claim 1, and hence are also inventive over D1.

D1 in the light of D2

The Examiner asserts that document D2 can be combined with D1 to lead to the invention. D2 discloses a fabric comprising a first ply, on the skin side, made of fibres having a relatively high Denier, and a second ply, on the side away from the skin, having a relatively low Denier. The fabric is said to draw sweat and other bodily fluids away from the body.

D2, like D1 is entirely silent on the provision of at least two layers bonded to each other by bounding yarns which are part of the layer that faces away from the skin, the bounding yarns being woven or knitted or stitched through the ply on the skin side.

The provision of bounding yarns, as in the fabric of the invention, results in improved moisture transport away from the wearer to the outer surface of the fabric, where it can evaporate. With the fabric of the invention, perspiration formed on the skin is picked up via

the fibre dots (5) and transported to the outside by the capillary action of the bounding yarns (see page 6, lines 3-7 of the Application). D2 does not teach or suggest this arrangement.

If one combined D1 with D2, one would not arrive at the fabric of the invention.

Furthermore, the elements of the fabrics of D1 and D2 do not lend themselves to combination, as there is no way to fit the elements of the fabrics disclosed in these documents together without making significant structural changes. It is not clear how a closed-cell foam laminated with adhesive to a fabric (D1) can be readily combined with a two-layer fabric (D2).

The fabric of the invention shows an inventive step with respect to D1 in the light of D2. The arguments mentioned above with respect to Claim 1 apply equally to dependent Claims 2 to 13. Claims 2 to 13 are inventive over D1 in the light of D2.

The articles of Claims 14, 15 and 16 comprise the inventive fabric of Claim 1, and hence are also inventive over D1 in the light of D2.

Conclusion

Claim 1 has been amended to better distinguish over the prior art. The amended claims are inventive over the prior art.

Very truly yours,



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JEG:kl
Enclosures

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WO 04/037027

Amended claims (revision mode)

1. Multilayered, breathable textile fabric (1) for articles of clothing with enhanced wearing comfort owing to easy moisture transport, characterized in that the textile fabric (1) comprises at least two separate layers (2,3), the two separate layers being bonded to each other at predefined positions (5) by means of selected bounding yarns which are part of the layer (3) which faces away from the skin, the bounding yams being woven or knitted or stitched through the ply (2) on the skin side [that are bonded to each other by means of dots or lines or else over the entire surface,] whose warp and weft yarns consist of aramid yarns or aramid twisted threads or aramid filament yarns or yarns made of blended fibers containing polybenzimidazole and aramid fibers, whereby the layers (2,3) have different individual fiber degrees of fineness in order to bring about a fineness gradient over the thickness (7) of the fabric (1), whereby the side (6) of the layer (2) [(3)] that essentially faces the skin has the coarser individual fiber titer and the layer of the side (4) facing away from the skin has the finer individual fiber titer.

2. The textile fabric according to Claim 1, characterized in that the layer (2) is a woven, a knitted fabric or a warp knitted fabric.

3. The textile fabric according to Claim 1, characterized in that the second layer (3) is a woven, a knitted fabric or a warp knitted fabric.

4. The textile fabric according to Claim 1,2 or 3, characterized in that all of the layers (2,3) have a structure exhibiting at least two different individual fiber finesses.

5. The textile fabric according to Claim 1 to 4, characterized in that it is a duplex construction with two layers bonded to each other.

6. The textile fabric according to one of Claims 1 to 5, characterized in that the layer (2) as well as the layer (3) are visible on the side (6) facing the skin, whereby, however, the surface proportion can vary.

7. The textile fabric according to one of Claims 1 to 6, characterized in that the re-drying time of the side (6) facing the skin is optimally shortened by the combination of extremely fine fibers and a large surface area of the article.

8. The textile fabric according to one of the preceding Claims 1 to 7, characterized in that the two layers (2,3) are bonded to each other by a special double-face weave, by a special double-face knit or by a special double-face warp knit.

9. The textile fabric according to one of the preceding Claims 1 to 8, characterized in that the layers (2,3) have a square meter weight in the range from 50g/m² to 450g/m², whereby the square meter weight of the individual layers can be identical or different.

10. The textile fabric according to one of the preceding Claims 1 to 9, characterized in that the layer (3) is arranged on the outside (4) or on the side (4) facing away from the skin and in that it has an individual fiber titer of less than 1.3 dtex.

11. The textile fabric according to Claim 1, characterized in that the warp yarns comprise multifilament aramid yarns or multifilament aramid twisted yarns or aramid filament yarns and the weft yarns alternately comprise multifilament aramid yarns or multifilament aramid twisted yarns or aramid filament yarns.

12. The textile fabric according to Claim 1 or 11, characterized in that the multifilament aramid yarns or multifilament aramid twisted threads or aramid filament yarns present in the weft yarns are similar or identical to one of the two alternately arranged, different multifilament yarns or multifilament twisted threads or aramid filament yarns that form the warp yarns.

13. The textile fabric according to [one of] Claim[s] 1 or 12 [and 13], characterized in that the aramid yarn contains fibers that are selected from the group consisting of poly-m-phenylene isophthalamide fibers, poly-p-phenylene terephthalamide fibers or mixtures of poly-m-phenylene isophthalamide and poly-p-phenylene terephthalamide fibers.

14. An article of clothing, characterized by a structure consisting of at least one two-layered textile composite having an inner layer, optionally a middle layer, made of a polyester or polyarnide or aramid microfiber fabric, and an outer layer, whereby the multilayered, breathable textile fabric according to one of Claims 1 to 13 forms the inner layer.

15. An article of work clothing for protection against the effects of heat, flames or electric arc and having a textile cover layer made of high-temperature- resistant fibers,

characterized by a structure made up of at least a two-layered textile composite having an inner layer, optionally a middle layer made of a polyester or polyarnide or aramid microfiber fabric, and an outer layer consisting of a textile material made of high-temperature-resistant fibers, whereby the inner layer contains a multilayered, breathable textile fabric according to one of Claims 1 to 13.

16. The article of work clothing according to Claim 15, characterized in that it is a fireproof jacket or fireproof pants.

CLAIMS

What is claimed is:

1. Multilayered, breathable textile fabric (1) for articles of clothing with enhanced wearing comfort owing to easy moisture transport, characterized in that
10 the textile fabric (1) comprises at least two separate layers (2,3); the two separate layers being bonded to each other at predefined positions (5) by means of selected bounding yarns which are part of the layer (3) which faces away from the skin, the bounding yams being woven or knitted or stitched through the ply (2) on the skin side, whose warp and weft yarns consist of aramid yarns or aramid twisted threads
15 or aramid filament yarns or yarns made of blended fibers containing polybenzimidazole and aramid fibers, whereby the layers (2,3) have different individual fiber degrees of fineness in order to bring about a fineness gradient over the thickness (7) of the fabric (1), whereby the side (6) of the layer (2) that essentially faces the skin has the coarser individual fiber titer and the layer of the
20 side (4) facing away from the skin has the finer individual fiber titer.
2. The textile fabric according to Claim 1, characterized in that the layer (2) is a woven, a knitted fabric or a warp knitted fabric.
- 25 3. The textile fabric according to Claim 1, characterized in that the second layer (3) is a woven, a knitted fabric or a warp knitted fabric.
- 30 4. The textile fabric according to Claim 1,2 or 3, characterized in that all of the layers (2,3) have a structure exhibiting at least two different individual fiber finesseses.
5. The textile fabric according to Claim 1 to 4, characterized in that it is a duplex construction with two layers bonded to each other.

5 6. The textile fabric according to one of Claims 1 to 5, characterized in
that the layer (2) as well as the layer (3) are visible on the side (6) facing the skin,
whereby, however, the surface proportion can vary.

10 7. The textile fabric according to one of Claims 1 to 6, characterized in
that the re-drying time of the side (6) facing the skin is optimally shortened by the
combination of extremely fine fibers and a large surface area of the article.

15 8. The textile fabric according to one of the preceding Claims 1 to 7,
characterized in that the two layers (2,3) are bonded to each other by a special
double-face weave, by a special double-face knit or by a special double-face warp
knit.

20 9. The textile fabric according to one of the preceding Claims 1 to 8,
characterized in that the layers (2,3) have a square meter weight in the range from
50g/m² to 450g/m², whereby the square meter weight of the individual layers can be
identical or different.

25 10. The textile fabric according to one of the preceding Claims 1 to 9,
characterized in that the layer (3) is arranged on the outside (4) or on the side (4)
facing away from the skin and in that it has an individual fiber titer of less than 1.3
dtex.

30 11. The textile fabric according to Claim 1, characterized in that the warp
yarns comprise multifilament aramid yarns or multifilament aramid twisted yarns or
aramid filament yarns and the weft yarns alternately comprise multifilament aramid
yarns or multifilament aramid twisted yarns or aramid filament yarns.

35 12. The textile fabric according to Claim 1 or 11, characterized in that the
multifilament aramid yarns or multifilament aramid twisted threads or aramid
filament yarns present in the weft yarns are similar or identical to one of the two

5 alternately arranged, different multifilament yarns or multifilament twisted threads or aramid filament yarns that form the warp yarns.

13. The textile fabric according to Claim 1 or 12, characterized in that the aramid yarn contains fibers that are selected from the group consisting of poly-m-phenylene isophthalamide fibers, poly-p-phenylene terephthalamide fibers or mixtures of poly-m-phenylene isophthalamide and poly-p-phenylene terephthalamide fibers.

14. An article of clothing, characterized by a structure consisting of at least one two-layered textile composite having an inner layer, optionally a middle layer, made of a polyester or polyarnide or aramid microfiber fabric, and an outer layer, whereby the multilayered, breathable textile fabric according to one of Claims 1 to 13 forms the inner layer.

15. An article of work clothing for protection against the effects of heat, flames or electric arc and having a textile cover layer made of high-temperature-resistant fibers, characterized by a structure made up of at least a two-layered textile composite having an inner layer, optionally a middle layer made of a polyester or polyarnide or aramid microfiber fabric, and an outer layer consisting of a textile material made of high-temperature-resistant fibers, whereby the inner layer contains a multilayered, breathable textile fabric according to one of Claims 1 to 13.

16. The article of work clothing according to Claim 15, characterized in that it is a fireproof jacket or fireproof pants.